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**Date:** 14 Oct 04

# Military Standard Order

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## **Subject: MSO-C144, AIRBORNE GLOBAL POSITIONING SYSTEM ANTENNA SYSTEM**

**1. PURPOSE.** This Military Standard Order (MSO) prescribes the minimum performance standard that airborne Global Positioning System (GPS) antenna system must meet to be identified with the applicable MSO marking. The similarity of this MSO with Technical Standard Order (TSO) -C144, "Airborne Global Positioning System Antenna", is intentional.

**2. APPLICABILITY.** The standards of this MSO apply to antenna systems that will be used to receive and provide Link 1 (L1) and Link 2 (L2) signals to a GPS Precise Positioning Service (PPS) navigation sensor or system, which provides information used to guide an aircraft in Required Navigation Performance (RNP) airspace. These standards do not address the use of the signals received through this antenna system for other applications.

**3. SUBSTITUTION.** Airborne GPS antenna systems identified with the MSO-C144 marking may substitute for airborne GPS antennas identified with a TSO-C144 marking in RNP-20 through RNP-0.3 area navigation (RNAV) operations, provided that: (a) the interface(s) between the antenna system and the intended PPS navigation sensor(s)/system(s) are compatible, (b) the RF interference environment at and around L1 is no more severe than that specified in paragraph 4 below, and (c) the antenna system performance at L1 is not degraded by the RF interference environment at and around L2. Airborne GPS antenna systems identified with the MSO-C144 marking are also expected to be acceptable substitutes for airborne GPS antennas identified with a TSO-C144 marking in lateral navigation/vertical navigation (LNAV/VNAV) and precision approach operations.

**4. REQUIREMENTS.** An airborne GPS antenna system that is to be so identified and that is manufactured on or after the date of this MSO must meet the standards set forth in Section 2 of RTCA/DO-228, "Minimum Operational Performance Standards for Global Navigation Satellite System (GNSS) Airborne Antenna Equipment", dated 20 Oct 95, except as specified herein. Change No. 1 to RTCA/DO-228, dated 11 Jan 00, is appropriately accounted for in this MSO and shall not be separately applied.

**a. Failure Condition Classification.** Failure of the function defined in paragraph 2 of this MSO has been determined to be a major failure condition for L1 in interference environments less severe than or as severe as the maximum civil interference environment defined in paragraph 4.b.(13) of this MSO and paragraph 2.2.2.6 of RTCA/DO-228. Failure of the function

defined in paragraph 2 of this MSO has been determined to be a minor failure condition for L1 in interference environments more severe than the maximum civil interference environment defined in paragraph 4.b.(13) of this MSO and paragraph 2.2.2.6 of RTCA/DO-228. Failure of the function defined in paragraph 2 of this MSO has been determined to be a minor failure condition for L2 regardless of the interference environment. The applicant must develop the system to at least the design assurance levels commensurate with these hazard classifications. (For definitions, see FAA AC 23.1309 and AC 25.1309.)

**b. Exceptions to RTCA/DO-228.**

(1) Precedence. In the event of a conflict between the performance requirements or conditions imposed by the prime item specification for the GPS antenna system and the performance requirements or conditions imposed by this MSO, either directly or indirectly through the invocation of requirements or conditions in a referenced RTCA document, the precedence of the performance requirements or conditions shall be as follows. Unless otherwise explicitly specified in this MSO, if the performance requirements or conditions imposed by the prime item specification are more rigorous than the requirements or conditions imposed by this MSO, then the performance requirements or conditions imposed by the prime item specification shall take precedence. However, if the prime item specification requirements or conditions do take precedence, only the minimum requirements or conditions of this MSO have to be met in order to be identified with the applicable MSO marking (see paragraph 6.a.(13)).

**NOTE:** As used herein, “prime item specification” is a generic term. It means the governing technical specification(s) for the airborne GPS antenna system.

(2) Equipment Performance and Test Procedure Deletions. The following paragraphs and Sections of RTCA/DO-228 are not applicable to equipment certified to this MSO: 2.2.1.2 and 2.4.2.2.

(3) GLONASS Satellites, GLONASS Operating Frequency, Etcetera. Delete all references to GLONASS satellites, GLONASS signals, GLONASS operating frequency or frequencies, etcetera in RTCA/DO-228 since the ability to receive GLONASS signals is not required.

(4) Assumptions. In lieu of the assumptions in paragraph 1.5 of RTCA/DO-228, substitute the following assumptions:

"It is assumed that the GNSS antenna will be used with GNSS (e.g., GPS PPS) receiver equipment defined in an appropriate MSO."

(5) Test Procedures. In addition to the information in paragraph 1.6 of RTCA/DO-228, add the following information:

"In particular, it is expected that many of the environmental tests required by the prime item specification(s) will supplant the testing specified herein."

(6) GPS Operating Frequencies. Change the title of paragraph 2.2.1.1 of RTCA/DO-228 to be "GPS Operating Frequencies" instead of "GPS Operating Frequency". In lieu of the requirements in paragraph 2.2.1.1 of RTCA/DO-228, substitute the following requirements:

"The GPS antenna shall operate over the minimum frequency bands of 1575.42 MHz  $\pm$ 10 MHz (L1) and 1227.60 MHz  $\pm$ 10 MHz (L2)."

(7) Antenna Gain. In lieu of the requirements in the first and second subparagraphs of paragraph 2.2.1.4 of RTCA/DO-228, substitute the following requirements:

"The minimum in-band gain in each operating frequency band shall not be less than the following for the specified elevation angle, at the operating frequencies, above the horizon at any azimuth. The gain at each elevation and azimuth angle shall not vary by more than 3 dB over each frequency band at a given temperature."

"The maximum in-band gain shall not exceed -2 dBic at 0 degrees elevation angle and 7 dBic above 5 degrees."

(8) Antenna Gain. In addition to the requirements in paragraph 2.2.1.4 of RTCA/DO-228, add the following requirement:

"The maximum out-of-band gain shall be as specified in the prime item specification."

(9) Axial Ratio. In lieu of the requirements in paragraph 2.2.1.5 of RTCA/DO-228, substitute the following requirements:

"The axial ratio shall not exceed 10 dB for all operating frequencies as measured at the boresight of the antenna."

(10) GNSS Antenna - With Integrated Preamplifier (optional). In addition to the definitions in paragraph 2.2.2 of RTCA/DO-228, add the following definition:

"The GNSS antenna, as defined in Section 2.2.1 above, integrated with a preamplifier, as illustrated in Figure 2-1, includes the antenna, cabling between the antenna and preamplifier, burnout protection, selective filtering, and low-noise amplifier (LNA) for each operating frequency. Down-converters, intermediate filters, digital processors, etcetera may also be included. The following requirements in this section apply to each operating frequency individually except as otherwise specified."

(11) Preamplifier Gain and Noise Figure. In lieu of the note in paragraph 2.2.2.1 of RTCA/DO-228, substitute the following note:

**NOTE:** *Unless otherwise specified in the prime item specification, the maximum gain shall be 45 dB.*

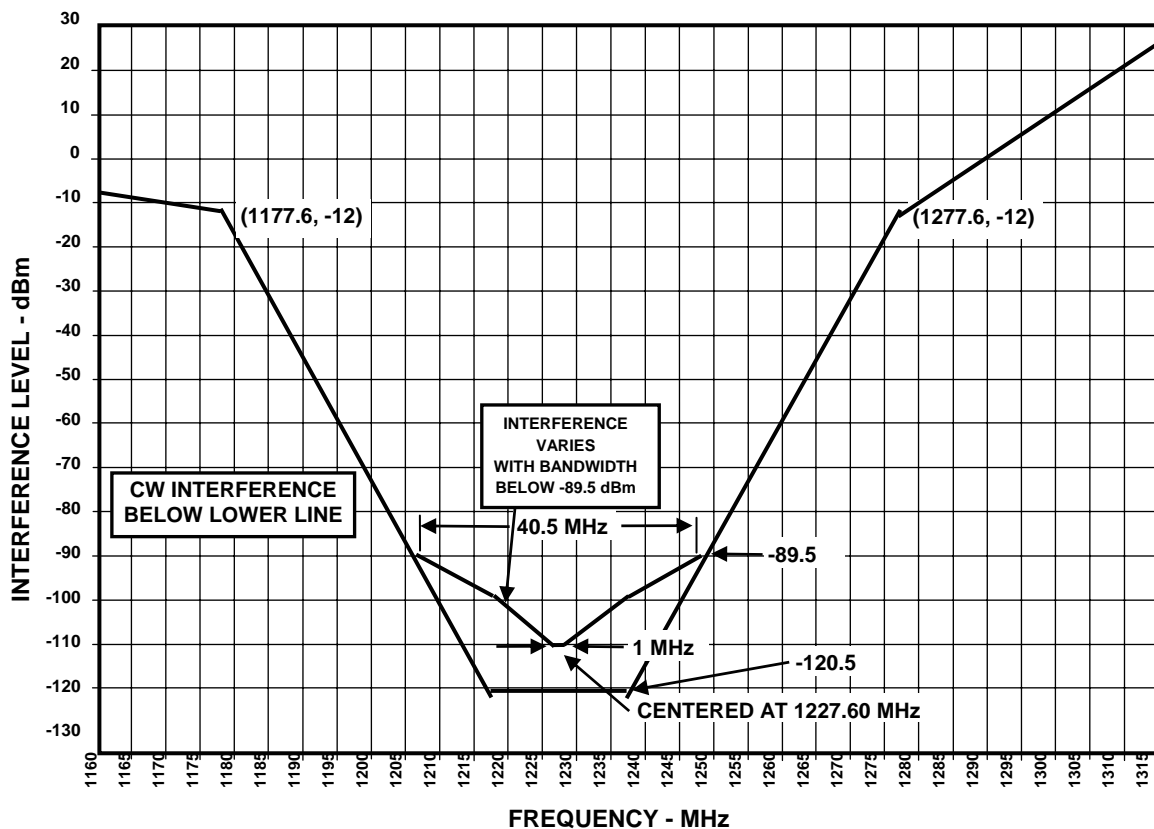
(12) Preamplifier Gain Compression. In lieu of the requirements in paragraph 2.2.2.2 of RTCA/DO-228, substitute the following requirements:

"The preamplifier shall have 1 dB compression points not less than the values shown in Figure 2-2a and Figure 2-2b defined at the antenna port. For Figure 2-2a, the CW interference levels below 1500 MHz increase linearly to 25.5 dBm at 1315 MHz, and above 1640 MHz, the levels increase linearly to 21.5 dBm at 2 GHz, accounting for High Intensity Radiation Fields (HIRF). For Figure 2-2b, the CW interference levels below 1177.6 MHz increase linearly to 25.5 dBm at 960 MHz, and above 1277.6 MHz, the levels increase linearly to 25.5 dBm at 1315 MHz."

(13) Figure 2-2. Change the numbering of Figure 2-2 to become Figure 2-2a, and change the title of the renumbered figure to become:

"Figure 2-2a L1 Interference Levels at the Antenna Port"

(14) New Figure 2-2b. Insert new Figure 2-2b as follows:



**Figure 2-2b L2 Interference Levels at the Antenna Port**

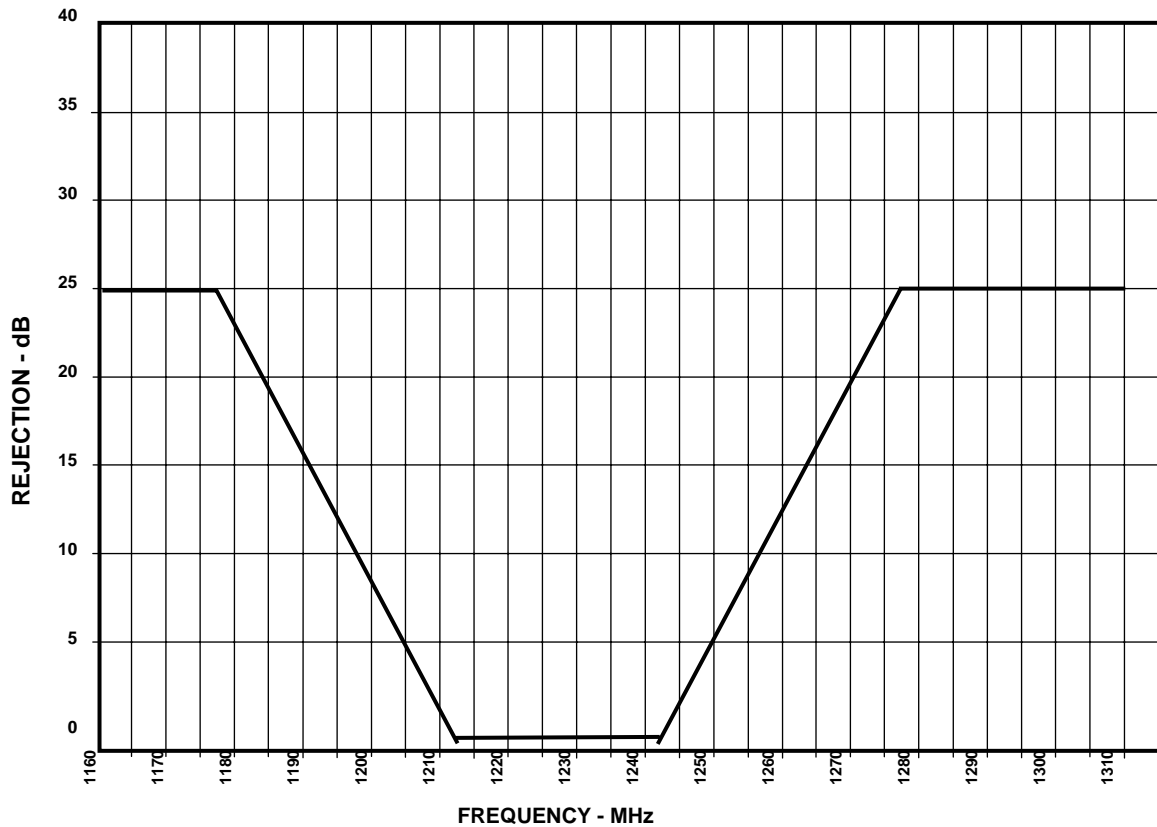
(15) Preamplifier Selectivity. In lieu of the requirements in paragraph 2.2.2.4 of RTCA/DO-228, substitute the following requirements:

"The preamplifier with antenna shall have the frequency selectivity specified in Figures 2-3a and 2-3b."

(16) Figure 2-3. Change the numbering of Figure 2-3 to become Figure 2-3a, and change the title of the renumbered figure to become:

"Figure 2-3a L1 Frequency Selectivity Requirements"

(17) New Figure 2-3b. Insert new Figure 2-3b as follows:



**Figure 2-3b L2 Frequency Selectivity Requirements**

(18) Differential Group Delay. Insert a new paragraph 2.2.2.7 in RTCA/DO-228 as follows:

**"2.2.2.7 Differential Group Delay**

The differential group delay of the preamplifier with antenna shall not exceed 50 nanoseconds for each operating frequency. The differential group delay is defined as:

$$\left| \frac{d\phi}{d\omega}(f_c) - \frac{d\phi}{d\omega}(f_{3dB}) \right|$$

where:

- $f_c$  is the bandpass filter center frequency
- $f_{3dB}$  are the 3 dB cutoff points of the filter
- $\phi$  is the phase response bandpass filter
- $\omega$  is the frequency

(19) L1-L2 Group Delay Difference. Insert a new paragraph 2.2.2.8 in RTCA/DO-228 as follows:

**"2.2.2.8 L1-L2 Group Delay Difference**

The group delay difference between the L1 and L2 operating frequencies shall not exceed 6 nanoseconds over the operating temperature range. The L1-L2 group delay difference is defined as the difference between the group delay measured at the center of the L1 operating frequency and the group delay measured at the center of the L2 operating frequency.

(20) GNSS Antenna - With Integrated Preamplifier and Interference Suppression (optional). Insert a new Section 2.2.3 in RTCA/DO-228 as follows:

**"2.2.3 GNSS Antenna - With Integrated Preamplifier and Interference Suppression (optional)**

The GNSS antenna, as defined in Section 2.2.1 above, integrated with a preamplifier, as defined in Section 2.2.2 above, integrated with interference suppression circuitry, includes at least one antenna, cabling between the antenna(s) and the preamplifier, burnout protection, selective filtering, and one or more LNAs for each operating frequency. Down-converters, intermediate filters, digital processors, software, adjustable gain controllers, adjustable phase controllers, polarization rejection filters, etcetera may also be included. The following requirements in this section apply to each operating frequency band individually except as otherwise specified.



### 2.2.3.1 Maximum Civil Interference Environment

The maximum civil interference environment is as defined in Figure 2-2a for the L1 operating frequency band and, in Figure 2-2b for the L2 operating frequency band, and in paragraph 2.2.2.6 for both the L1 and L2 operating frequency bands. The GNSS antenna together with integrated preamplifier and interference suppression circuitry shall meet the requirements in Sections 2.2.1 and 2.2.2 above for all interference environments less severe than or equal in severity to the maximum civil interference environment.

### 2.2.3.2 Military Interference Environments

The ranges of military interference environments are defined in the prime item specification for the GNSS antenna with integrated preamplifier and interference suppression circuitry. The GNSS antenna together with integrated preamplifier and interference suppression circuitry shall meet the requirements given in the prime item specification when subject to the ranges of military interference environments defined in the prime item specification. Compliance with the requirements in paragraphs 2.2.1.1 and 2.2.1.4 above is not required when the military interference environment is more severe than the maximum civil interference environment except to the extent specified in the prime item specification.

**NOTE:** *It is expected that GNSS antennas with integrated preamplifiers and interference suppression capabilities based on frequency excision techniques may not meet the requirements of paragraph 2.2.1.1 under severe military interference environments.*

**NOTE:** *It is expected that GNSS antennas with integrated preamplifiers and interference suppression capabilities based on adjustable antenna gain techniques may not meet the requirements of paragraph 2.2.1.4 under severe military interference environments."*

(21) Low Operating Temperature Test. In addition to the requirements in paragraph 2.3.2.1 of RTCA/DO-228, add the following requirement:

"7. Section 2.2.2.8 - L1-L2 Group Delay Difference (optional)"

(22) High Short-Time Operating Temperature Test. In addition to the requirements in paragraph 2.3.2.2 of RTCA/DO-228, add the following requirement:

"7. Section 2.2.2.8 - L1-L2 Group Delay Difference (optional)"

(23) High Operating Temperature Test. In addition to the requirements in paragraph 2.3.2.3 of RTCA/DO-228, add the following requirement:

"9. Section 2.2.2.8 - L1-L2 Group Delay Difference (optional)"

(24) Test Cross-Reference. In lieu of the test cross-reference matrix in Table 2-4 of RTCA/DO-228, substitute the following test cross-reference matrix:

Table 2-4 Test Cross Reference

Requirement	Subject	Tests
2.2.1.1	GPS Operating Frequency	2.4.2.1
2.2.1.3	VSWR and Impedance	2.4.2.3
2.2.1.4	Gain	2.4.2.4
2.2.1.4.1	Frequency Stability	2.4.2.4
2.2.1.4.2	Frequency Selectivity	2.4.2.4
2.2.1.5	Axial Ratio	2.4.2.5
2.2.1.6	Polarization	2.4.2.6
2.2.2.1, 2.2.3.1	Gain and Noise Figure (optional)	2.4.3.1
2.2.2.2, 2.2.3.1	Preamplifier Gain Compression (optional)	2.4.3.2
2.2.2.3, 2.2.3.1	Preamplifier Stability (optional)	2.4.3.3
2.2.2.4, 2.2.3.1	Preamplifier Selectivity (optional)	2.4.3.4
2.2.2.5, 2.2.3.1	Burnout Protection (optional)	2.4.3.5
2.2.2.6, 2.2.3.1	Pulse Power Operation (optional)	2.4.3.6
2.2.2.7, 2.2.3.1	Differential Group Delay (optional)	2.4.3.7
2.2.2.8, 2.2.3.1	L1-L2 Group Delay Difference (optional)	2.4.3.8

(25) Test Frequencies. In lieu of the equipment test procedure requirements in paragraph 2.4.1.9 of RTCA/DO-228, substitute the following requirements:

"Antenna Subsystem measurements shall be performed at six frequencies per operating frequency band to include:

<u>Test Frequency</u>	<u>Receive</u>
L1 Lower Band-edge	1565.42 MHz
L1 Mid-Band	1575.42 MHz
L1 Upper Band-edge	1585.42 MHz
L2 Lower Band-edge	1217.60 MHz
L2 Mid-Band	1227.60 MHz
L2 Upper Band-edge	1237.60 MHz"

(26) GNSS Antenna - With Preamplifier. In addition to the equipment test procedure requirements in paragraph 2.4.3 of RTCA/DO-228, add the following information:

"It may be necessary to adjust the following test conditions when testing an integrated preamplifier and interference suppression circuitry so as to not exceed the input levels corresponding to the maximum civil interference environment (see paragraph 2.2.3.1)."

(27) RF Gain and Noise Figure Test. In addition to the equipment test procedure requirements in paragraph 2.4.3.1 of RTCA/DO-228, add the following requirements.

Under RF Gain:

"5. Repeat step 3 for 1217.60 MHz to 1237.60 MHz and then repeat step 4."

Under Noise Figure Test:

"4. Verify that the noise figure is no more than 4 dB over the frequency band of 1217.60 MHz to 1237.60 MHz."

**(28) Preamplifier Gain Compression Test.** In lieu of the equipment test procedure requirement in step 4 of paragraph 2.4.3.2 of RTCA/DO-228, substitute the following requirement:

"4. Adjust the signal generator frequencies and levels to produce the signals as a function of frequency as described in Figures 2-2a and 2-2b."

**(29) Preamplifier Selectivity Test.** In lieu of the equipment test procedure requirements in steps 3 and 4 of paragraph 2.4.3.4 of RTCA/DO-228, substitute the following requirements:

"3. Adjust the network analyzer to provide a constant, linearly swept signal level of -60 dBm, or as appropriate, over the frequency ranges of 1500 to 1660 MHz and 1160 to 1310 MHz.

4. Verify that the displayed signal meets the levels specified in Figures 2-3a and 2-3b relative to the input signal level."

**(30) Burnout Protection Test.** In addition to the equipment test procedure requirements in paragraph 2.4.3.5 of RTCA/DO-228, add the following requirement:

"8. Repeat steps 1 to 7 with the RF generator set to a frequency of 1227.60 MHz."

**(31) Pulse Power Operation Test.** In addition to the equipment test procedure requirements in paragraph 2.4.3.6 of RTCA/DO-228, add the following requirement:

"6. Repeat steps 1 to 5 with signal generator #2 set to a frequency of 1227.60 MHz with reference to Table 2-1B for the additional test settings for validation of the pulse power operation requirement.

Table 2-1B Additional Test Settings for Validation of the Pulse Power Operation Requirement

Test	RF Frequency	Pulse Width	PRF	RF Peak Power
1	1315.00 MHz	1 ms	22 pps	+30 dBm
2	1277.00 MHz	1 ms	100 pps	+30 dBm
3	1237.60 MHz	1 ms	100 pps	+30 dBm
4	1227.60 MHz	1 ms	100 pps	+30 dBm
5	1217.60 MHz	1 ms	100 pps	+30 dBm
6	1177.00 MHz	1 ms	100 pps	+30 dBm
7	1160.00 MHz	1 ms	100 pps	+30 dBm
8	960.00 MHz	1 ms	56 pps	+30 dBm

(32) Differential Group Delay Test. Insert a new paragraph 2.4.3.7 in RTCA/DO-228 as follows:

**"2.4.3.7 Differential Group Delay Test (Section 2.2.2.7)**

Equipment Required:

Antenna Test set (to provide power as required by the manufacturer to the preamplifier)  
Microwave Transition Analyzer (Agilent HP 71500A or equivalent) or Network Analyzer

Measurement Requirements

1. Connect the analyzer to the preamplifier.
2. Measure the group delay for a carrier at 1565.42 MHz, 1575.42 MHz, and 1585.42 MHz.
3. Verify that the preamplifier meets the differential group delay specified in paragraph 2.2.2.7 for the L1 operating frequency.
4. Repeat steps 2 and 3 for a carrier at 1217.60 MHz, 1227.60 MHz, and 1237.60 MHz, and verify that the preamplifier meets the differential group delay specified in paragraph 2.2.2.7 for the L2 operating frequency."

(33) L1-L2 Group Delay Difference. Insert a new paragraph 2.4.3.8 in RTCA/DO-228 as follows:

**"2.4.3.8 L1-L2 Group Delay Difference Test (Section 2.2.2.8)**

Equipment Required:

Antenna Test set (to provide power as required by the manufacturer to the preamplifier)  
Microwave Transition Analyzer (Agilent HP 71500A or equivalent) or Network Analyzer

### Measurement Requirements

1. Connect the analyzer to the preamplifier.
2. Measure the group delay for a carrier at 1575.42 MHz and 1227.60 MHz.
3. Verify that the preamplifier meets the L1-L2 group delay difference specified in paragraph 2.2.2.8."

**c. Functional Qualifications.** The required performance shall be demonstrated under the test conditions specified in RTCA/DO-228, Section 2.4. The use of test procedures other than specified in Sections 2.4.2 and 2.4.3 of RTCA/DO-228, except as specified herein, constitutes a deviation to this MSO.

**d. Environmental Qualifications.** The equipment shall be subject to the test conditions as specified in RTCA/DO-160D, "Environmental Conditions and Test Procedures for Airborne Equipment", Change 3, dated July 29, 1997, except as specified herein. See paragraph 4.b.(1) above for precedence of environmental qualification requirements in the event of conflict between the prime item specification for the equipment and this MSO.

**e. Software Qualifications.** If the article includes software, the software must be developed in accordance with or a method comparable to Sections 3-11 and Annex A of RTCA/DO-178B, "Software Considerations in Airborne Systems and Equipment Certification", dated December 1, 1992 (e.g., see EUROCAE ED-12B). If the software is qualified using criteria contained in Section 2 or Section 12 of DO-178B, MSO applicants must apply for deviations. Deviations are more likely to be approved if the software levels are adequately substantiated in the safety assessment.

**5. MARKING.** In addition to the markings specified in 14 CFR § 21.607(d), recognizing that the governing document in this case is an MSO rather than a TSO, the following requirements apply to equipment manufactured under this MSO:

**a.** At least one major component must be permanently and legibly marked with all of the information listed in 14 CFR § 21.607(d).

**b.** Each separate component of equipment must be permanently and legibly marked with at least the name of the manufacturer, manufacturer's part number, and the MSO number.

**c.** If the component includes software, the part number must include hardware and software identification, or separate part numbers may be utilized for hardware and software. The part number must uniquely identify the hardware and software design, including modification status.

d. When applicable, identification that the article is an incomplete system or that the article accomplishes additional functions beyond the minimum described in paragraphs 2, 3, and 4 of this MSO.

## **6. DATA REQUIREMENTS.**

a. Data to be provided with the application. In addition to documents specified in 14 CFR §§ 21.605(a)(1) and (3) and in accordance with § 21.605(a)(2), recognizing that the governing document in this case is an MSO rather than a TSO, the manufacturer must furnish the PPS Equipment Certification Office (PECO) at the GPS Joint Program Office one copy each of the following technical data to support the design and production approval:

(1) Operating instructions and equipment limitations. The limitations shall be sufficient to describe the operational capability of the equipment.

(2) Installation procedures and limitations. The limitations shall be sufficient to ensure that the article, when installed in accordance with the installation procedures, continues to meet the requirements of this MSO. The limitations shall also be sufficient to identify any unique aspects of the installation. The limitations shall include at least the following:

(a) A note with the following statement:

“The conditions and tests required for MSO approval of this article are minimum performance standards. It is the responsibility of those desiring to install this article either on or within a specific type or class of aircraft to determine that the article, when installed, performs in accordance with the design specifications that meet this MSO. The article may be installed only if further evaluation by the applicant documents an acceptable installation and is approved by the appropriate Service airworthiness certification authority, e.g., ASC/EN, GATO/MC2 System Program Office for the Air Force, AMRDEC/AED for the Army, and OPNAV N78 for the Navy.”

(b) Specification of whether the antenna incorporates a preamplifier; and if so, then what type of preamplifier system (preamplifier alone, preamplifier/interference suppression, etcetera).

(c) Adequate specification of the interface between the antenna or preamplifier system and the intended PPS navigation sensor(s)/system(s) to ensure proper functioning of the integrated system. This must include maximum tolerable currents and voltages at the antenna port along with signal frequencies.

(d) The currents and voltages induced by high current tests of paragraph 23.6.3 of RTCA/DO-160D must be specified so that compatibility with a receiver can be verified at installation.

(e) When applicable, identification that the article is an incomplete system or a multi-use system. This must describe the functions that are provided by the article. Any added interference suppression functionality shall be explicitly identified along with a description of the operation of the functionality under the interference environments defined in Section 4 of this MSO.

(3) Schematic drawings as applicable to the installation procedures.

(4) Wiring drawings as applicable to the installation procedures.

(5) Specifications, particularly including the prime item specification.

(6) List of the components (by part number) that make up the equipment system complying with the standards prescribed in this MSO.

(7) Instructions for periodic maintenance and calibration that are necessary for continued airworthiness.

(8) An environmental qualifications form as described in RTCA/DO-160D for each component of the system.

(9) Manufacturer's MSO qualification test report.

(10) Nameplate drawing.

(11) A drawing list, enumerating all of the drawings and processes that are necessary to define the article's design.

(12) If the article includes software: Plan for Software Aspects of Certification (PSAC), Software Configuration Index, and Software Accomplishment Summary.

NOTE: The PECO recommends that the PSAC be submitted early in the software development process. Early submittal will allow timely resolution of issues such as partitioning and determination of software levels.

(13) Proposed deviations and waivers, if any.

**b. Data that must be available upon request.** In addition to those data requirements that are to be furnished directly to the PECO, each manufacturer must have available for review by the manager of the PECO, the following technical data:

(1) The functional qualification specifications to be used to qualify each production article to ensure compliance with this MSO.

- (2) Qualification test procedures used to determine compliance with this MSO.
- (3) Equipment calibration procedures.
- (4) Corrective maintenance procedures (within 12 months after MSO authorization).
- (5) Schematic drawings.
- (6) Wiring diagrams.
- (7) The results of the environmental qualification tests conducted in accordance with RTCA/DO-160D.
- (8) If the article includes software, the appropriate documentation as defined in RTCA/DO-178B or comparable method, including all data supporting the applicable objectives found in Annex A of RTCA/DO-178B, Process Objectives and Outputs by Software Level.

**c. Data to be Furnished with Manufactured Units.**

- (1) One copy of the data and information specified in paragraphs 6.a.(1) through (8) of this MSO must be provided to each purchaser of one or more articles manufactured under this MSO.
- (2) If the article accomplishes any additional functions beyond that described in paragraph 2 of this MSO, then a copy of the data and information specified in paragraphs 6.a.(9) through (13) must also be provided to each purchaser of one or more articles manufactured under this MSO.

## **7. AVAILABILITY OF REFERENCED DOCUMENTS**

**a.** Copies of RTCA/DO-160D, DO-178B, and DO-228 may be purchased from RTCA Inc., 1828 L Street, N.W, Suite 805, Washington, D.C. 20036, or from their Internet website at [www.rtca.org](http://www.rtca.org).

**b.** You may buy copies of Federal Aviation Regulations 14 CFR § 21, Subpart O, from the Superintendent of Documents, Government Printing Office, Washington, DC 20402-9325. Copies also may be obtained from the Government Printing Office (GPO), electronic CFR Internet website at [www.access.gpo.gov/ecfr/](http://www.access.gpo.gov/ecfr/).

**c.** Advisory Circular (AC) 20-110 (current revision), "Index of Aviation Technical Standard Orders," and AC 20-115 (current revision), "Radio Technical Commission for Aeronautics, Inc., Document RTCA/DO-178B," may be obtained from the U.S. Department of Transportation, Subsequent Distribution Office, Ardmore East Business Center, 3341 Q 75th Ave, Landover, MD 20785, telephone (301) 322-4477 or FAX (301) 386-5394. Copies also may be obtained from the FAA Internet website at [www.faa.gov/certification/aircraft/TSOA.htm](http://www.faa.gov/certification/aircraft/TSOA.htm).



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Acting Manager, PECO  
GPS Joint Program Office

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